EARLY LIFE STAGES OF NOTOTHENIOIDEI FROM THE KERGUELEN ISLANDS

by

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ABSTRACT. - Morphology, meristics and pigmentation have been used in combination with knowledge of adult reproduction and habitat to identify larvae of Notothenioidei from the Kerguelen Islands. The larvae have been collected regularly with plankton since 1986. Eleven species belonging to this sub-order occur in the Indian sector of the Southern Ocean. Most of the descriptions of larvae are original and include seven species of Nototheniidae, two species of Channichthyidae and one of Harpagiferidae. The features observed on the larvae reinforce the distinctions between the genera and sub-genera of the Nototheniidae suggested by Andersen (1984).

RÉSUMÉ. - Les critères morphologiques, méristiques et pigmentaires associés à la connaissance de la biologie des adultes (reproduction et habitat) ont permis l'identification des larves de Notothenioidei présents autour des Iles Kerguelen. Régulièrement depuis 1986, les larves ont été collectées dans le plancton. Onze espèces sont reconnues pour ce sous-ordre, dans cette partie indienne de l'océan Austral. Les descriptions des larves sont pour la plupart originales et portent sur sept espèces de Nototheniidae, deux de Channichthyidae et une d'Harpagiferidae. Les caractères observés sur les larves semblent conforter la distinction des genres et sous-genres proposés par Andersen (1984) pour les Nototheniidae.

Key-words: Notothenioidei, Nototheniidae, Channichthyidae, Harpagiferidae, Kerguelen Islands, Ichthyoplankton, Larval characters.

Three families of Notothenioidei (Nototheniidae, Harpagiferidae and Channichthyidae) including eleven species occur at the Kerguelen Islands (Indian sector of the Southern Ocean). The Nototheniidae are the most represented with up to eight species. All these species are demersal on the shelf and coastal zone. Five of them are endemic to the area: *Channichthys rhinoceratus, Harpagifer kerguelensis, Notothenia cyanobrancha, Notothenia acuta* and *Nototheniops mizops*. The biology of the juveniles and adults of the main species was studied closely (Hureau, 1966, 1970; Duhamel, 1982, 1984, 1987a,b). Nonetheless, almost no data are available concerning the early life stages and no description of these has been made. Surveys dealing with both the nearshore zone and the wide island shelf have allowed us to investigate the early life history stages.

MATERIAL AND METHODS

Since the first trials in 1983 on the Kerguelen shelf (Duhamel, 1984), ichthyoplankton samples have been taken from 1986 onwards. Morbihan Bay, situated on the eastern coastal zone of the archipelago, was selected because of its

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accessible situation. There, eight stations were sampled monthly. Due to its size and limited opportunities, the nearshore zone (< 100 m isobath), the shelf and the surrounding deep oceanic zone were investigated at intervals during seasonal oceanographic cruises in 1985 - MD42 SIBEX - (Camus, 1990) from the French research vessel "Marion Dufresne" and in 1987-1988 from the Soviet Research trawler "Skif". Unfortunately, no samples were taken off-shore during the austral spring.

The Bongo-net was used for ichthyoplankton sampling as recommended by Smith and Richardson (1977) and Hureau (1982). This sampling-device consists of two frames of 63 cm diameter. Each frame is equipped with a cylindrical conical net of 0.5 mm mesh and 3.6 m long. Two flowmeters fixed on the centre of each frame were used to measure the volume of water filtered by the net. Oblique tows were made at a speed between 2-3 knots. For shallow tows (depth < 200 m) the Bongo-net was lowered close to the bottom. Otherwise, it was lowered to 200 metres depth. This towing procedure seems to be adapted to the Southern ocean since Kellermann (1986) found that 98.6% of ichthyoplankton (from the Antarctic Peninsula) occurred in the upper 200 metres. This finding is confirmed by the observations recorded during the EPOS Oceanographic Cruise in 1989 (Hureau *et al.*, 1990).

The zooplankton was entirely preserved in sea-water formalin which was buffered with sodium borate. It was kept in darkness at a temperature of between 5 and 10°C. Afterwards, in the laboratory, samples were sorted and fish larvae removed under a stereomicroscope. The illustrations were made using a camera lucida.

The species identification of fish larvae was based on morphology (body shape, head shape and gut shape) and melanophore pigmentation. This was described according to the terminology used by Russell (1976), Hureau (1982) and Leis and Trnsky (1989). Four developmental criteria were noted considering the presence of a yolk sac, the notochord flexion, the formation of fins and metamorphosis. The developmental stages linked to those criteria are:

stage 1: yolk sac larva;
stage 2: preflexion larva;
stage 3: postflexion larva;
stage 4: transition larva and juvenile, fin-rays formed.

The size range of each stage was tabulated for each species. The reference length (RL) is the standard length. For the first two stages, reference length is notochord length. Body proportions are mainly related to reference length or to head length (HL). These measurements are the body depth (BD), head length, eye diameter (ED) and preanal length (PAL). These measures and observations are based on about 30 larvae for each stage and species. Meristic characteristics were: number of myomeres (divided into pre and postanal elements), number of fin-rays, and number of vertebrae observed after staining by means of alizarin (Dingerkus and Uhler, 1977).

Each stage was illustrated according to the techniques recommended by Faber and Gadd (1983) and Balon and Fleger-Balon (1985). For the illustrations, a larva considered as representative of each particular development stage was used.

Series of larvae of different sizes, but which are identical as far as morphology and pigmentation (number and pattern) are concerned, were used to identify the species. These were identified from the oldest stage with priority given to meristic characteristics.

RESULTS

Recognition of both Channichthyidae and Harpagiferidae was of little difficulty, but that of the Nototheniidae was more difficult although some species

Table I: Meristic characters of Notothenioidei taken on adult specimens from Kerguelen Islands.

SPECIES	DORSAL FIN 1							
	3	4	5	6	7	8	9	10
Paranotothenia magellanica		X	X					
Notothenia (N) coriiceps coriiceps		X	X					
Notothenions mizops			X					
Notothenia (N) rossii rossii		X	X	X				
Notothenia (G) cyanobrancha		X	X	X				
Notothenia (L) squamifrons			X	X				
Notothenia (G) acuta			X	X	X			
Dissostichus eleginoides							X	X
Harpagifer kerguelensis	X	X						
Channichthys rhinoceratus				X	X	X	X	
Champsocephalus gunnari						X	X	X

SPECIES	DORSAL FIN 2													
	22	23	28	29	30	31	32	33	34	35	36	37	38	
Notothenia (G) acuta			X	X	X									
Dissostichus eleginoides			X	X	X									
Paranotothenia magellanica			X	X	X	X								
Notothenia (N) rossii rossii							X	X	X	X	X			
Notothenia (L) squamifrons							X	X	X	X	X			
Notothenia (N) coriiceps coriiceps								X	X	X	X	X	X	
Notothenia (G) cyanobrancha								X	X	X	X	X	X	
Notothenions mizops										X	X	X		
Harpagifer kerguelensis	X	X												
Channichthys rhinoceratus					X	X	X	X	X					
Champsocephalus gunnari										X	X	X	X	

SPECIES	ANAL FIN																		
	17	18	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	
Paranotothenia magellanica			X	X	X														
Notothenia (N) rossii rossii						X	X	X	X										
Notothenia (N) coriiceps coriiceps							X		X	X									
Dissostichus eleginoides								X	X	X	X								
Notothenia (G) acuta									X	X	X								
Notothenia (G) cyanobrancha									X	X	X	X							
Notothenia (L) squamifrons											X	X	X						
Notothenions mizops												X	X	X	X				
Harpagifer kerguelensis	X	X																	
Channicnthys rhinoceratus							X	X	X	X	X	X	X						
Champsocephalus gunnari																X	X	X	X

SPECIES	PECTORAL FIN												
	16	17	18	19	20	21	22	23	24	25	26	27	28
Paranotothenia magellanica	X	X											
Notothenia (N) coriiceps coriiceps		X	X										
Notothenia (G) acuta				X	X								
Notothenia (G) cyanobrancha				X	X	X	X						
Notothenions mizops						X	X						
Notothenia (N) rossii rossii						X	X	X					
Dissostichus eleginoides							X	X	X	X	X		
Notothenia (L) squamifrons									X	X	X		
Harpagifer kerguelensis		X	X										
Channicthys rhinoceratus			X	X	X	X	X						
Champsocephalus gunnari										X	X	X	X

SPECIES	VERTEBRAE																		
	33-38	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	
Notothenia (G) acuta		X	X	X															
Paranotothenia magellanica			X	X															
Notothenia (G) cyanobrancha			X	X	X	X													
Notothenions mizops					X	X	X	X											
Notothenia (L) squamifrons							X	X	X										
Notothenia (N) rossii rossii								X	X	X									
Notothenia (N) coriiceps coriiceps									X			X							
Dissostichus eleginoides											X	X	X						
Harpagifer kerguelensis	X..X																		
Channichthys rhinoceratus											X	X	X	X	X	X			
Champscocephalus gunnari															X	X	X	X	

are different from others based on the adult meristic criteria (Table I). To confirm our identifications, we compared our observations with knowledge of the bathymetric range and spawning periods of each species (Duhamel, 1987a).

Bathymetric separation of Nototheniidae adults and their spawning areas allows us to discriminate between:

- coastal species (*Notothenia cyanobrancha, Paranotothenia magellanica* and *Notothenia coriiceps coriiceps*),

- species living in the inner-shelf (*Notothenia acuta*) and even on the top of seamounts *(Nototheniops mizops)*,

- and, species which occur near the outer shelf as adults (*Notothenia rossii rossii* and *Notothenia squamifrons*) or at greater depth - on the slope - *(Dissostichus eleginoides)*. The spawning areas of Kerguelen fishes are geographically well situated (Duhamel, 1987a).

Analysis of the spawning periods of each species showed that the spawn occur at different seasons (Duhamel, 1987b): - during autumn for *Paranotothenia magellanica, Notothenia cyanobrancha* and *Notothenia coriiceps coriiceps*; - during winter for *Nototheniops mizops, Notothenia rossii rossii, Notothenia acuta* and *Dissostichus eleginoides*; - during spring for *Notothenia squamifrons*. The length of the larvae at hatching (which is correlated with egg diameter) was considered as a supplementary information.

All these previous elements (morphology, pigmentation, bathymetric separation and spawning period) permitted the identification of 10 species. About 2000 larvae were studied. As for the Kerguelen Islands, one must notice that the larvae of Myctophidae mesopelagic species represented 97% of the catch over the shelf and the oceanic zone (Koubbi, unpub. report). Notothenioidei larvae descriptions will be presented species by species.

NOTOTHENIIDAE

Dissostichus eleginoides **Smitt, 1898** (Fig. 1)

Juveniles of this species were described for the Atlantic sector (Efremenko, 1979b, 1983; North and White, 1982) and Crozet Islands in the Indian sector (Duhamel, 1987a,b). Ciechomski and Weiss (1976) described larvae from a bank located between South America and South Georgia. New descriptions of early-stages larvae - from South Georgia - are given by Kellermann (1989).

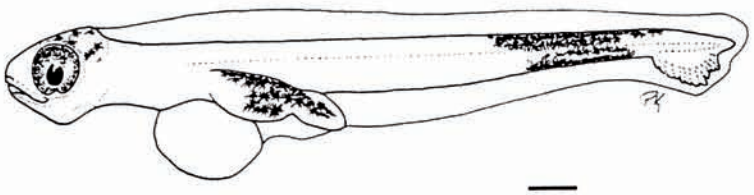

Fig. 1: Yolk sac larva of *Dissostichus eleginoides*. Scale: 1 mm.

Around Kerguelen Islands, the spawning occurs in the deeper-western part of the shelf, during austral winter (Duhamel, 1987a,b). An egg - 4.6 mm in diameter - (Morbihan Bay, Oct. 30, 1988), close to hatching was collected in late October and was used for the description of the yolk-sac larva.

Morphology and morphometrics: It is a relatively long larva (SL = 14.5 mm) of an elongated shape (BD = 7.79% SL). The head is small (HL = 9.09% SL) with a rather pointed snout. No teeth are visible. The eyes are large and round (ED = 35.74% HL). Preanal length is equal to 43.28% SL.

Myomeres: Myomere counts give 9 preanal elements and at least 34 postanal elements (which were very difficult to distinguish).

Pigmentation: Table II.

Table II: Melanophore pigmentation of *Dissostichus eleginoides*.

	EPIDERMAL		INTERNAL	
HEAD:	**orbital**	no pigments	**otolithic**	no pigments
	snout	no pigments	**shoulder**	no pigments
	mandibular	no pigments		
	opercular	no pigments		
	occipital	branched or stellate		
	shoulder	no pigments		
BODY:	**dorsal contour**	no pigments	**peritoneal**	abundant, branched
	ventral contour	no pigments	**notochordal**	no pigments
	medio-lateral	vertical band on posterior post-anal section, branched	**haemal**	no pigments
	abdominal	branched, sides, ventral and anal		
	throat	no pigments		
FINS:		no pigments		

Notothenia (Notothenia) rossii rossii **Richardson, 1844** (Fig. 2)

No larva of this species has been collected up to now. Larvae used for the description of stage 1 were obtained after artificial fertilization of eggs (mean diameter 4.8 mm) from fishes collected during the austral winter (late June) on the spawning ground (slope in the south-eastern part of the Kerguelen shelf). Embryonic development until hatching took 70-100 days (Camus and Duhamel, 1985).

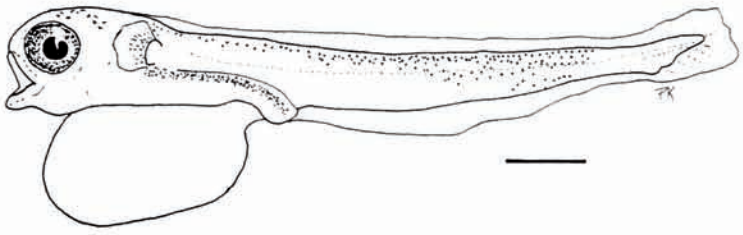

Fig. 2: Yolk sac larva of *Notothenia (Notothenia) rossii rossii*. Scale: 1 mm.

Morphology and morphometrics: Yolk-sac larva morphometrics were studied by Camus and Duhamel (1985). They gave for 9 specimens the following measurements: reference length is between 9.1 and 10.5 mm, preanal length is equal to 38 to 45% SL, the eye diameter is between 0.6 to 0.8 mm. Two of those specimens were analysed again (Table III). The body is elongated. The head is small with a short snout.

STAGE 1	n	min	max
RL	2	9.10	10.50
BD (% RL)	2	11.21	12.19
HL (% RL)	2	18.24	18.86
ED (%HL)	2	36.14	38.38
PAL (% RL)	2	42.31	46.48

Table III: Morphological and meristic characters of yolk sac larva of *Notothenia (Notothenia) rossii rossii*. RL: reference length; BD: body depth; HL: head length; ED: eye diameter; PAL: preanal-length; n: number of specimens; avg: mean; std: standard deviation; max: maximum; min: minimum.

Myomeres: Myomere counts give for the 9 specimens 14 to 15 preanal elements and 36 postanal elements (Camus and Duhamel, 1985).

Pigmentation: Table IV.

***Notothenia (Lepidonotothen) squamifrons* Günther, 1880** (Fig. 3)

Some larval-stages of this species were described by Efremenko (1983, 1984) for the Atlantic sector. As for the Kerguelen area, two spwaning grounds are found (Duhamel, 1987a,b). One of them is located in the south-eastern part of the shelf and the second in the outer part of a nearby seamount. Spawning occurs during the austral spring (Duhamel and Ozouf-Costaz, 1985; Duhamel, 1987a,b). Yolk-sac larvae are found in ichthyoplankton from the end of November. Larvae

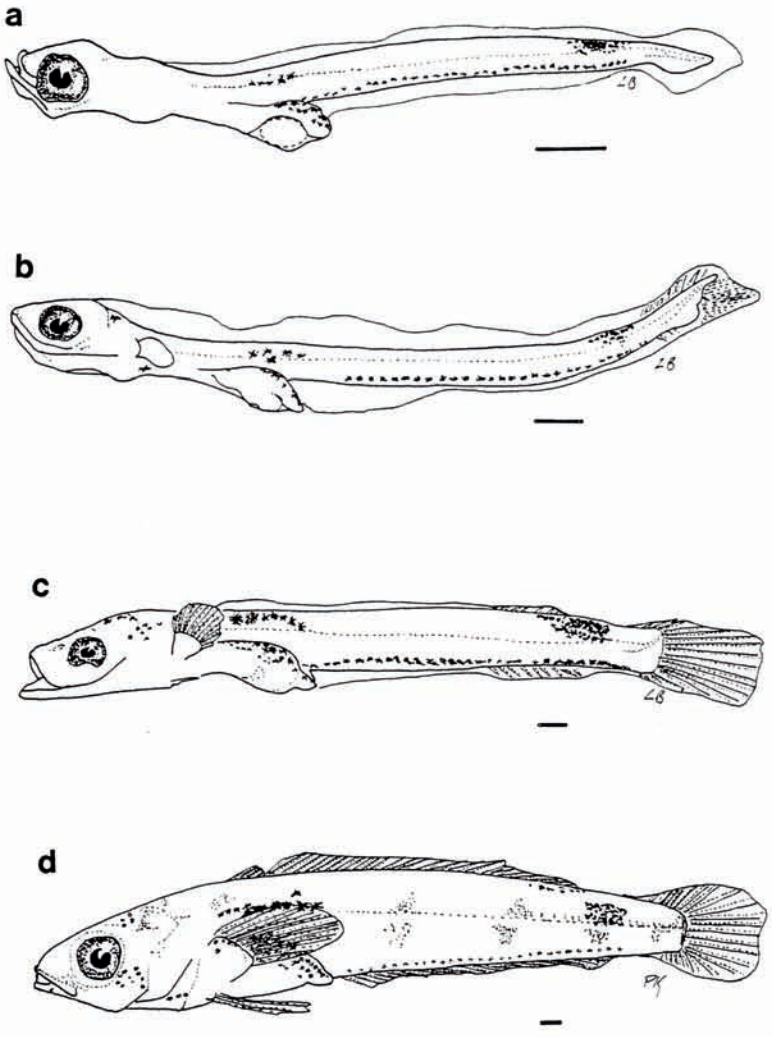

Fig. 3: Larvae of *Notothenia (Lepidonotothen) squamifrons*. a) stage 1; b) stage 2; c) stage 3; d) stage 4-juvenile. Scale: 1 mm.

leave the pelagic domain at the end of autumn. They are localized on the shelf and the surrounding seamounts (Koubbi, unpub. rep.).

Morphology and morphometrics: Table V. The body is slender. The head is short with a pointed snout. The eyes are round and of moderate size in comparison with that of the head. The gut is relatively long.

Pigmentation: Table VI.

Table IV: Melanophore pigmentation of *Notothenia (Notothenia) rossii rossii.*

	EPIDERMAL		INTERNAL	
HEAD:	**orbital**	no pigments	**otolithic**	no pigments
	snout	no pigments	**shoulder**	no pigments
	mandibular	no pigments		
	opercular	no pigments		
	occipital	stellate		
	shoulder	stellate		
BODY:	**dorsal contour**	double, punctate or stellate	**peritoneal**	abundant, punctate
	ventral contour	no pigments	**notochordal**	no pigments
	medio-lateral line	abundant dorso and ventral- on the 2nd third of post-anal section	**haemal**	no pigments
	abdominal	no pigments		
	throat	no pigments		
FINS:		no pigments		

Table V: Morphological and meristic characters of larvae of *Notothenia (Lepidonotothen) squamifrons*. For abbreviations, see Table III.

STAGE 1	n	avg	std	min	max
RL	2			7.5	7.9
BD (% RL)	2			4.6	5.8
HL (% RL)	2			14.1	16.8
ED (%HL)	2			28.6	47.2
PAL (% RL)	2			37.8	38.3
STAGE 2					
RL	85	10.80	2.18	6.2	15.0
BD (% RL)	28	6.08	0.79	4.5	7.6
HL (% RL)	28	19.39	1.36	15.3	21.8
ED (%HL)	28	29.92	3.33	22.4	38.8
PAL (% RL)	28	41.27	2.46	34.4	45.5
STAGE 3					
RL	350	21.43	4.81	10.1	30.4
BD (% RL)	29	6.82	1.08	5.3	9.1
HL (% RL)	29	19.62	1.00	16.9	21.3
ED (%HL)	29	29.30	2.29	24.5	33.9
PAL (% RL)	29	40.91	4.38	20.1	46.1
STAGE 4					
RL	7	29.87	4.95	23.7	35.9
BD (% RL)	6	14.17	2.50	11.0	17.7
HL (% RL)	6	25.12	1.22	23.7	26.8
ED (%HL)	6	26.63	2.73	22.9	32.1
PAL (% RL)	6	43.58	1.14	41.9	45.0
MYOMERES					
PRE-ANAL	28	12.29	1.36	10	15
POST-ANAL	28	34.75	1.53	31	37
TOTAL	28	47.04	1.50	43	50

Notothenia (Gobionotothen) acuta Günther, 1880 (Fig. 4)

This inner shelf species spawns at the end of the austral winter (August) (Duhamel, 1987b). Yolk-sac larvae appear in October. The end of the pelagic phase is likely to be the end of autumn. Larvae are found in the nearshore zone.

Morphology and morphometrics: Table VII. At an identical stage, the body of these larvae is less elongated than the other Nototheniidae. The head is of moderate size with a short snout in the early stages; and becomes relatively pointed in the late larvae. The eyes are large and round. The gut is relatively long.

Pigmentation: Table VIII.

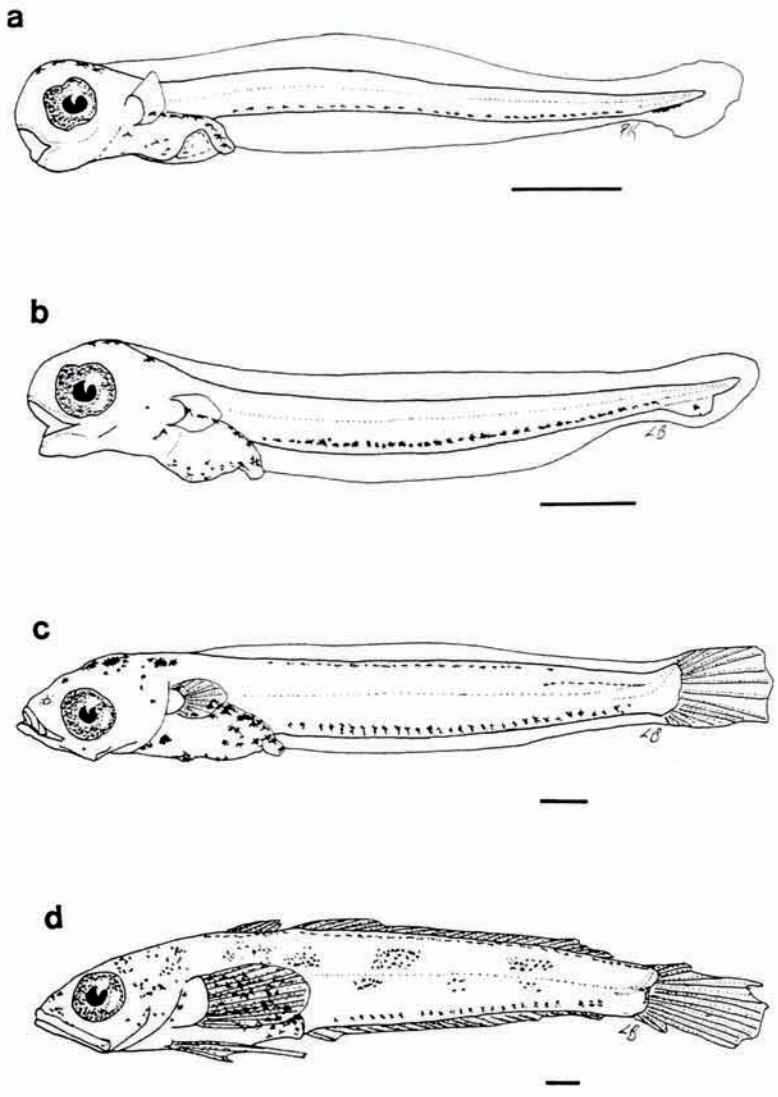

Fig. 4: Larvae of *Notothenia (Gobionotothen) acuta*. a) stage 1; b) stage 2; c) stage 3; d) stage 4-juvenile. Scale: 1 mm.

Table VI: Melanophore pigmentation of *Notothenia (Lepidonotothen) squamifrons.*

	EPIDERMAL		INTERNAL	
HEAD:	orbital	no pigments	otolithic	> stage 3
	snout	no pigments	shoulder	> stage 3
	mandibular	stage 4, some punctate		
	opercular	stage 4, some punctate and stellate		
	occipital	> stage 3, few stellate and punctate		
	shoulder	stage 2, very few stellate; after, few stellate and punctate		
BODY:	dorsal contour	no pigments	peritoneal	stellate
	ventral contour	single, stellate, 27 to 35	notochordal	> stage 3
	medio-lateral line	dorso band- on posterior post-anal section, 3-7 stellate above pectoral fin	haemal	no pigments
	abdominal	anal, stellate		
	throat	> stage 3, few stellate		
FINS:	caudal	> stage 3, base		
	pectoral	fin base		
	pelvic	no pigments		
	finfolds	no pigments		

Table VII: Morphological and meristic characters of larvae of *Notothenia (Gobionotothen) acuta.* For abbreviations, see Table III.

STAGE 1	n	avg	std	min	max
RL	72	5.68	0.43	4.1	6.5
BD (% RL)	27	9.97	1.21	8.2	12.4
HL (% RL)	27	15.80	1.48	12.6	18.9
ED (%HL)	27	43.97	4.09	36.4	53.9
PAL (% RL)	27	29.18	1.92	26.2	32.7
STAGE 2					
RL	204	7.01	1.28	4.8	10.8
BD (% RL)	32	11.57	1.32	9.2	14.5
HL (% RL)	32	17.60	1.98	14.1	22.9
ED (%HL)	32	43.88	4.24	36.8	53.3
PAL (% RL)	32	31.11	2.63	26.0	37.9
STAGE 3					
RL	29	10.52	0.98	8.6	12.8
BD (% RL)	23	13.53	1.21	10.4	16.4
HL (% RL)	23	20.16	1.53	18.2	24.4
ED (%HL)	23	37.33	3.77	30.7	43.5
PAL (% RL)	23	35.33	1.90	32.4	40.5
STAGE 4					
RL	18	15.62	5.32	11.6	33.8
BD (% RL)	15	16.28	4.65	11.5	32.8
HL (% RL)	15	24.52	2.78	19.9	29.0
ED (%HL)	15	31.16	4.72	23.3	40.0
PAL (% RL)	15	40.46	2.53	37.5	44.8
MYOMERES					
PRE-ANAL	61	8.33	0.86	7	11
POST-ANAL	61	36.02	0.90	34	38
TOTAL	61	44.32	1.07	41	47

Table VIII: Melanophore pigmentation of *Notothenia (Gobionotothen) acuta.*

	EPIDERMAL		INTERNAL	
HEAD:	orbital	no pigments	otolithic	> stage 3
	snout	> stage 3, few stellate	shoulder	no pigments
	mandibular	> stage 3, very few stellate		
	opercular	> stage 3, some stellate		
	occipital	abundant, stellate or branched		
	shoulder	stellate or branched, quite abundant		
BODY:	dorsal contour	stage 3, double, some stellate	peritoneal	abundant, stellate
		> stage 3, double, continuous	notochordal	no pigments
	ventral contour	single, stellate, 25 to 35	haemal	no pigments
	medio-lateral line	advanced stage 4, 5 vertical bands		
	abdominal	side, anal, ventral, stellate		
	throat	some stellate or branched		
FINS:	caudal	> stage 3, base		
	pectoral	> stage 3, fin base		
	pelvic	no pigments		
	finfolds	no pigments		

Notothenia (Gobionotothen) cyanobrancha Richardson, 1844 (Fig. 5)

This species is found in shallow waters. Hureau (1970) described two spawning periods according to the age of fishes: either January or April-May. Consequently, yolk-sac larvae were found at two periods of the year: in the summer and at the end of the austral winter. The larvae of this species were caught throughout the year but only in the nearshore zone.

Morphology and morphometrics: Table IX. The body is slender. The head is relatively small with a short round snout during the young stages which becomes pointed in later larvae. The eyes are large and round.

Pigmentation: Table X.

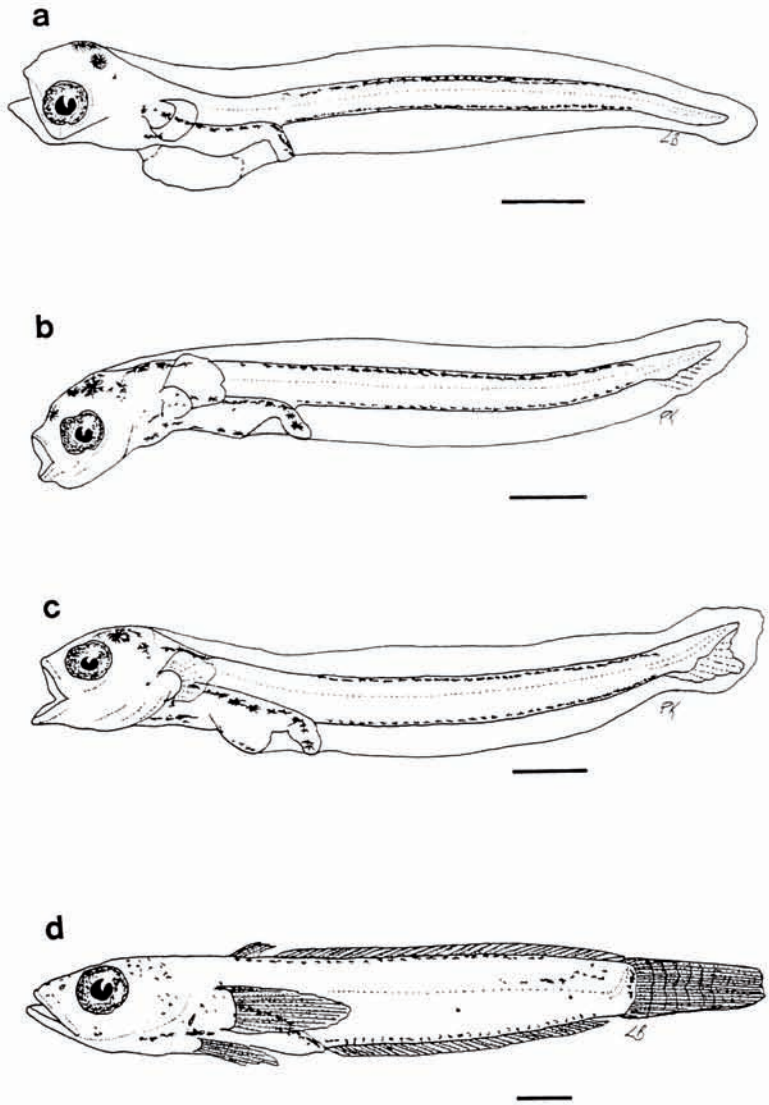

Fig. 5: Larvae of *Notothenia (Gobionotothen) cyanobrancha*. a) stage 1; b) stage 2; c) stage 3; d) stage 4. Scale: 1 mm.

Table IX: Morphological and meristic characters of larvae of *Notothenia (Gobionotothen) cyanobrancha*. For abbreviations, see Table III.

STAGE 1	n	avg	std	min	max
RL	49	7.20	1.14	6.1	10.2
BD (% RL)	33	11.30	1.05	9.4	13.5
HL (% RL)	33	16.32	0.94	14.3	18.8
ED (%HL)	33	38.94	3.25	34.0	46.9
PAL (% RL)	33	37.72	2.17	32.2	40.9
STAGE 2					
RL	80	9.00	1.22	5.8	11.2
BD (% RL)	32	9.82	1.16	6.4	12.0
HL (% RL)	32	17.56	1.43	14.8	20.3
ED (%HL)	32	34.82	4.37	27.9	45.3
PAL (% RL)	32	37.66	1.92	34.3	43.1
STAGE 3					
RL	71	11.61	1.39	8.9	14.9
BD (% RL)	30	10.46	0.95	8.4	12.5
HL (% RL)	30	19.23	1.93	14.6	22.6
ED (%HL)	30	29.24	3.21	22.8	34.8
PAL (% RL)	30	39.12	2.02	34.5	43.2
STAGE 4					
RL	122	22.31	4.10	14.9	32.7
BD (% RL)	32	12.27	1.27	10.8	18.3
HL (% RL)	32	24.19	1.29	20.3	26.4
ED (%HL)	32	24.36	2.13	21.2	29.3
PAL (% RL)	32	42.24	1.43	39.9	46.8
MYOMERES					
PRE-ANAL	116	11.31	0.89	10	13
POST-ANAL	116	33.77	1.14	32	37
TOTAL	116	44.98	1.43	41	50

Table X: Melanophore pigmentation of *Notothenia (Gobionotothen) cyanobrancha*.

	EPIDERMAL		INTERNAL	
HEAD:	**orbital**	no pigments	**otolithic**	> stage 3
	snout	> stage 3, few stellate	**shoulder**	> stage 3
	mandibular	> stage 3, sometimes		
	opercular	> stage 3, few stellate		
	occipital	some branched or stellate		
	shoulder	> stage 1, some branched or stellate		
BODY:	**dorsal contour**	double, continuous, stellate, 31-37	**peritoneal**	abundant, stellate
	ventral contour	single, continuous, stellate, 28-32	**notochordal**	> stage 3
	medio-lateral line	no pigments	**haemal**	no pigments
	abdominal	anal, ventral, stellate or branched		
	throat	no pigments		
FINS:	**caudal**	> stage 3, base		
	pectoral	fin base		
	pelvic	no pigments		
	finfolds	no pigments		

Nototheniops mizops (Günther, 1880) (Figs. 6, 7)

The spawning period of this species occurred between May and June in the inner shelf (Duhamel, 1984, 1987b). Two groups of larvae were observed depending on pigment patterns and bathymetric separation (near coastal zone or shelf). The early larvae were found on the shelf from the end of July. The pelagic phase of older larvae may end during spring (Koubbi, unpub. report). Yolk-sac larvae are present in the coastal zone in October.

Morphology and morphometrics: Tables XI, XII. The body is slender. The head is small. The snout is short and round during the young stages and becomes pointed in later larvae. The eyes are large and round. The gut is relatively long.

Pigmentation: Tables XIII, XIV.

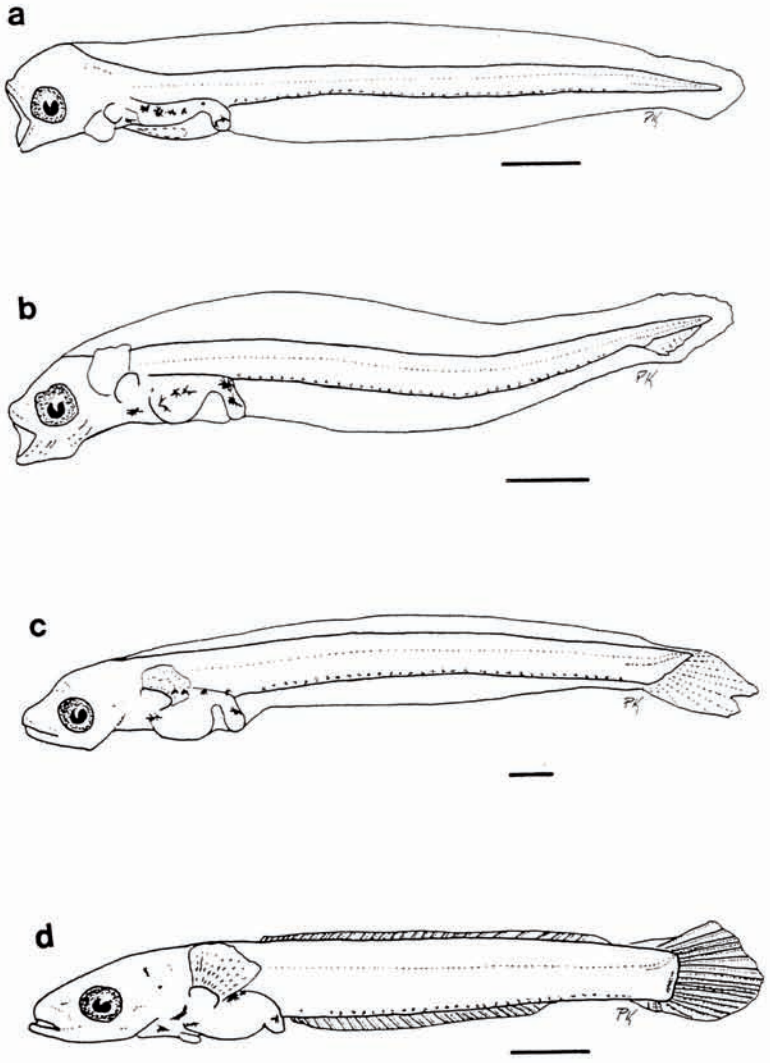

Fig. 6: Larvae of *Nototheniops mizops*, coastal zone. a) stage 1; b) stage 2; c) stage 3; d) stage 4. Scale: 1 mm.

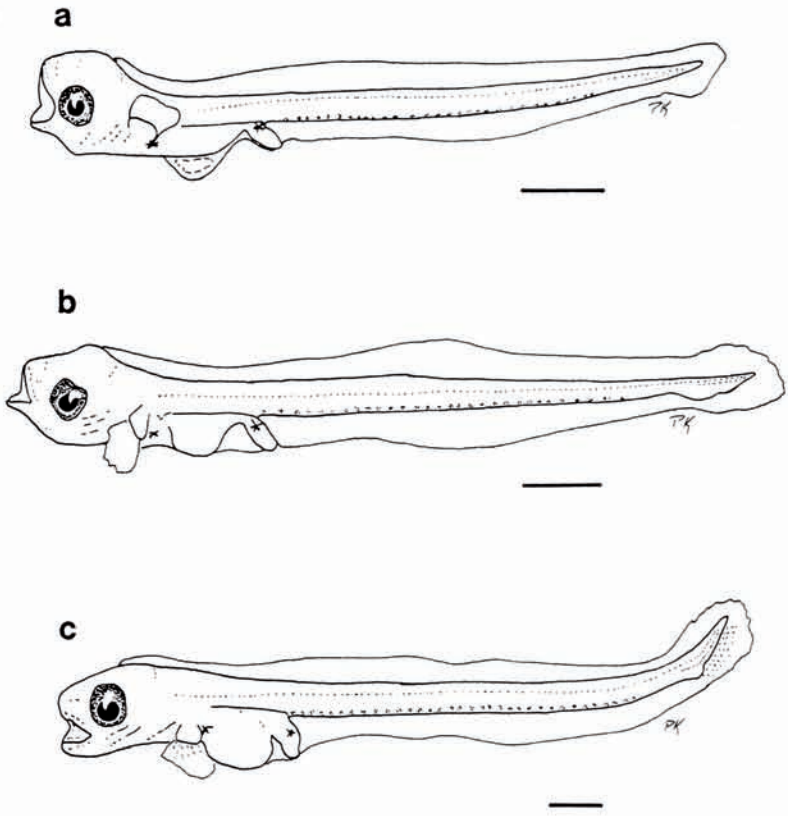

Fig. 7: Larvae of *Nototheniops mizops*, shelf. a) stage 1; b) stage 2; c) stage 3. Scale: 1 mm.

Table XI: Morphological and meristic characters of larvae of *Nototheniops mizops*, coastal zone. For abbreviations, see Table III.

STAGE 1	n	avg	std	min	max
RL	15	7.76	1.01	5.4	9.4
BD (% RL)	12	8.57	1.46	7.0	12.3
HL (% RL)	13	13.86	1.18	12.1	16.4
ED (%HL)	12	42.34	7.36	31.9	61.8
PAL (% RL)	13	30.84	1.86	28.7	34.7
STAGE 2					
RL	15	8.50	1.69	5.8	12.5
BD (% RL)	12	9.05	1.23	7.2	12.3
HL (% RL)	11	16.70	1.60	13.7	20.2
ED (%HL)	11	34.85	3.76	26.9	40.2
PAL (% RL)	12	33.87	3.72	27.5	39.9
STAGE 3					
RL	7	14.34	1.24	12.6	16.0
BD (% RL)	5	10.26	0.35	9.6	10.7
HL (% RL)	5	19.24	1.00	17.8	20.6
ED (%HL)	5	27.26	3.21	23.9	31.4
PAL (% RL)	5	33.79	1.95	30.6	35.9
STAGE 4					
RL	8	29.48	4.39	21.3	34.0
BD (% RL)	7	15.70	2.09	12.1	18.8
HL (% RL)	7	23.96	2.49	18.3	26.3
ED (%HL)	7	27.64	1.93	24.4	30.2
PAL (% RL)	7	40.66	1.90	38.2	44.4
MYOMERES					
PRE-ANAL	20	9.20	0.68	8	11
POST-ANAL	20	37.45	1.20	35	39
TOTAL	20	46.65	1.28	43	48

Table XII: Morphological and meristic characters of larvae of *Nototheniops mizops*, shelf. For abbreviations, see Table III.

STAGE 1	n	avg	std	min	max
RL	6	8.54	0.33	8.1	9.0
BD (% RL)	6	8.11	0.73	7.1	9.1
HL (% RL)	6	13.63	0.62	12.7	14.6
ED (%HL)	6	37.41	3.09	33.9	43.5
PAL (% RL)	6	31.38	1.88	29.1	34.0
STAGE 2					
RL	51	10.69	1.77	7.5	13.9
BD (% RL)	38	8.91	0.93	6.6	10.7
HL (% RL)	38	16.21	1.87	12.5	19.7
ED (%HL)	30	33.45	3.86	24.1	41.9
PAL (% RL)	37	33.44	1.74	29.6	36.8
STAGE 3					
RL	10	14.02	2.09	12.8	20.2
BD (% RL)	8	10.36	0.78	9.0	11.1
HL (% RL)	8	18.09	2.08	16.2	22.5
ED (%HL)	7	30.67	3.33	24.4	35.8
PAL (% RL)	7	34.96	2.05	32.9	38.6
MYOMERES					
PRE-ANAL	35	10.66	0.89	9	13
POST-ANAL	35	37.80	1.39	35	40
TOTAL	35	48.46	1.73	45	52

Table XIII: Melanophore pigmentation of *Nototheniops mizops*, coastal zone.

	EPIDERMAL		INTERNAL	
HEAD:		no pigments		no pigments
BODY:	**dorsal contour**	no pigments	**peritoneal**	no pigments
	ventral contour	single, punctate, 33-37	**notochordal**	no pigments
	medio-lateral line	no pigments	**haemal**	no pigments
	abdominal	side, 1-3; anal, 2-3; stellate		
	throat	stellate, 1-2		
FINS:	**caudal**	> stage 3, fin base, some punctate		
	pectoral	no pigments		
	pelvic	no pigments		
	finfolds	no pigments		

Table XIV: Melanophore pigmentation of *Nototheniops mizops*, shelf.

	EPIDERMAL		INTERNAL	
HEAD:		no pigments		no pigments
BODY:	**dorsal contour**	no pigments	**peritoneal**	no pigments
	ventral contour	single, punctate, 33-36	**notochordal**	no pigments
	medio-lateral line	no pigments	**haemal**	no pigments
	abdominal	side, none or one stellate; anal, 1		
	throat	one stellate		
FINS:		no pigments		

Nototheniidae sp. (Fig. 8)

Identification of these kinds was not possible because of the lack of juveniles. Yolk-sac larvae appear in the coastal zone in April. The spawning period is probably in the middle of the austral summer. Larvae leave the pelagic domain at the end of winter.

Morphology and morphometrics: Table XV. The body is slender. The head is small with a short snout during the first stages. The eyes are large and round.

Fins and vertebrae: Fin-ray counts for one specimen (LS = 18 mm) was: D1 = 4, D2 = 33, A = 32. No staining was done on the stage 4 specimen for vertebrae counts since it was decided to keep it for future registration on the Museum collection.

Pigmentation: Table XVI.

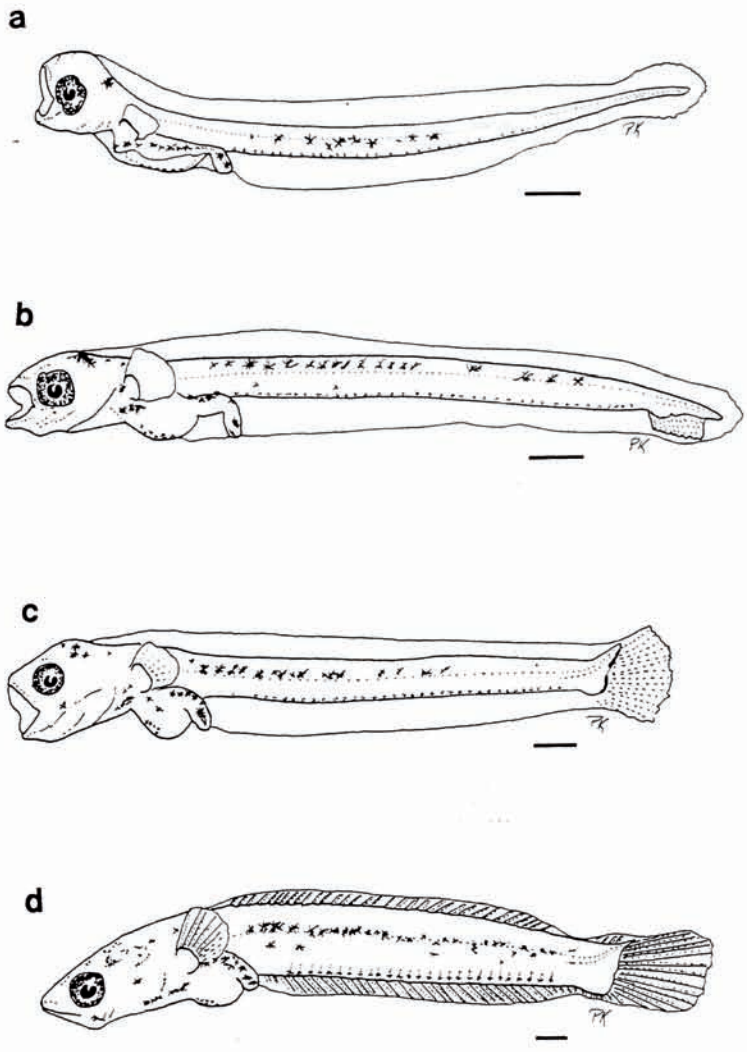

Fig. 8: Larvae of Nototheniidae sp.. a) stage 1; b) stage 2; c) stage 3; d) stage 4. Scale: 1 mm.

Table XV: Morphological and meristic characters of larvae of Nototheniidae sp.. For abbreviations, see Table III.

STAGE 1	n	avg	std	min	max
RL	1	7.94			
BD (% RL)	1	5.16			
HL (% RL)	1	10.08			
ED (%HL)	1	51.25			
PAL (% RL)	1	29.47			
STAGE 2					
RL	4	9.72	1.70	8.1	12.2
BD (% RL)	4	8.85	0.87	7.9	10.2
HL (% RL)	4	14.04	0.83	12.6	14.7
ED (%HL)	4	35.39	2.78	31.1	38.5
PAL (% RL)	4	30.58	1.12	28.6	31.3
STAGE 3					
RL	3	13.39	0.95	12.7	14.7
BD (% RL)	3	9.90	0.44	9.5	10.5
HL (% RL)	3	17.48	0.47	17.1	18.2
ED (%HL)	3	31.23	1.24	29.9	32.9
PAL (% RL)	3	34.21	0.88	33.0	34.9
STAGE 4					
RL	2			16.4	18.7
BD (% RL)	2			13.0	13.0
HL (% RL)	2			19.2	21.7
ED (%HL)	2			30.9	33.1
PAL (% RL)	2			34.0	38.1
MYOMERES					
PRE-ANAL	9	10.11	0.57	9	11
POST-ANAL	9	37.56	1.77	35	40
TOTAL	9	47.67	1.70	45	49

Table XVI: Melanophore pigmentation of Nototheniidae sp.

	EPIDERMAL		INTERNAL	
HEAD:	**orbital**	no pigments	**otolithic**	> stage 3
	snout	no pigments	**shoulder**	> stage 3
	mandibular	no pigments		
	opercular	no pigments		
	occipital	few branched or stellate		
	shoulder	no pigments		
BODY:	**dorsal contour**	stage 4, some	**peritoneal**	some branched
	ventral contour	single, stellate, 33-37	**notochordal**	no pigments
	medio-lateral line	dorso-, > 10, stellate or branched along myoseptal lines	**haemal**	no pigments
	abdominal	anal, ventral, branched or stellate		
	throat	some stellate		
FINS:	**caudal**	> stage 3, some on fin base		
	pectoral	> stage 3, some on fin base		
	pelvic	no pigments		
	finfolds	no pigments		

HARPAGIFERIDAE

Harpagifer kerguelensis Nybelin, 1947 (Fig. 9)

Larvae of this family were described by North and White (1982) and Efremenko (1983). They were all from the Atlantic sector of the Southern ocean. Kellermann (1989) identified those larvae as *Harpagifer antarcticus*. No descriptions are available concerning *Harpagifer kerguelensis* larvae. No data exist dealing

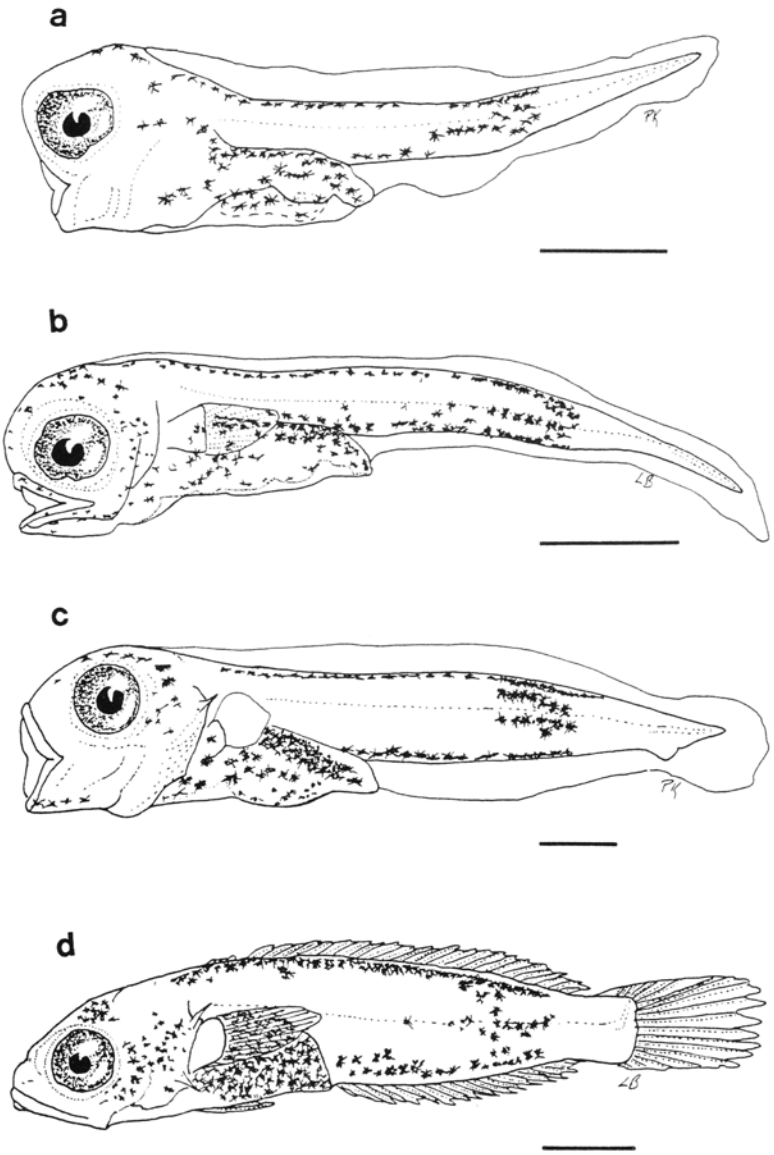

Fig. 9: Larvae of *Harpagifer kerguelensis*. a) stage 1; b) stage 2; c) stage 3; d) stage 4. Scale: 1 mm.

with the reproduction of this shallow water species. Yolk-sac larvae appear in December in the coastal zone and the ichthyoplanktonic phase may finish by the end of the summer.

Morphology and morphometrics: Table XVII. These larvae have a typical shape when compared with those of the two other families. The body is short and deep. The head is massive with a short snout. The gut is short. Opercular and preopercular spines, (typical characteristics of this family) appear at stage 3.

Pigmentation: Table XVIII.

Table XVII: Morphological and meristic characters of larvae of *Harpagifer kerguelensis*. For abbreviations, see Table III.

STAGE 1	n	avg	std	min	max
RL	45	6.19	0.62	4.8	8.4
BD (% RL)	31	15.84	1.94	12.9	20.2
HL (% RL)	31	20.61	2.02	17.6	25.2
ED (%HL)	31	46.98	3.88	39.0	55.8
PAL (% RL)	31	45.54	2.60	39.4	54.8
STAGE 2					
RL	59	8.01	1.15	5.2	10.0
BD (% RL)	29	17.13	1.69	14.0	19.8
HL (% RL)	29	21.64	1.90	17.8	24.4
ED (%HL)	29	44.57	4.72	33.5	52.6
PAL (% RL)	29	45.52	2.28	39.4	49.7
STAGE 3					
RL	70	10.13	1.02	7.3	11.7
BD (% RL)	31	19.12	1.29	14.0	21.4
HL (% RL)	31	23.49	2.36	14.6	26.9
ED (%HL)	31	39.71	5.86	30.0	62.9
PAL (% RL)	31	47.89	2.24	41.8	51.6
STAGE 4					
RL	90	15.11	4.52	8.6	24.6
BD (% RL)	33	20.44	1.30	17.9	23.1
HL (% RL)	33	26.26	3.07	22.8	34.5
ED (%HL)	33	35.96	4.35	26.3	44.3
PAL (% RL)	33	49.95	2.81	43.7	56.0
MYOMERES					
PRE-ANAL	26	10.54	0.75	9	12
POST-ANAL	26	22.50	0.89	21	24
TOTAL	26	33.04	1.19	31	35

Table XVIII: Melanophore pigmentation of *Harpagifer kerguelensis*.

	EPIDERMAL		INTERNAL	
HEAD:	**orbital**	post-	**otolithic**	> stage 3
	snout	sometimes	**shoulder**	some
	mandibular	> stage 1, some stellate		
	opercular	abundant, stellate or branched		
	occipital	abundant, stellate or branched		
	shoulder	abundant, stellate or branched		
BODY:	**dorsal contour**	double, stellate-branched, 25 to 33	**peritoneal**	abundant
	ventral contour	double, stellate-branched, 13 to 18	**notochordal**	> stage 3
	medio-lateral line	lines on posterior post-anal section	**haemal**	no pigments
	abdominal	early stages, branched and stellate		
		> stage 3, very abundant, branched		
	throat	branched or stellate		
FINS:	**caudal**	no pigments		
	pectoral	fin base		
	pelvic	no pigments		
	finfolds	no pigments		

CHANNICHTHYIDAE

***Champsocephalus gunnari* Lönnberg, 1905** (Fig. 10)

The larvae of this species were described for the Atlantic sector of the Southern Ocean (Efremenko, 1979a, 1983). Around the Kerguelen Islands, the spawning always occurs in winter on the shelf and in autumn on the seamounts (Duhamel, 1987a,b). Larvae - linked to the shelf spawn - were collected in the coastal zone during September to November.

Morphology and morphometrics: Table XIX. The body is elongate. The head is relatively large with a long flattened snout, and teeth are visible. The gut is short. Pelvic fins are present as early as stage 1.

Pigmentation: Table XX.

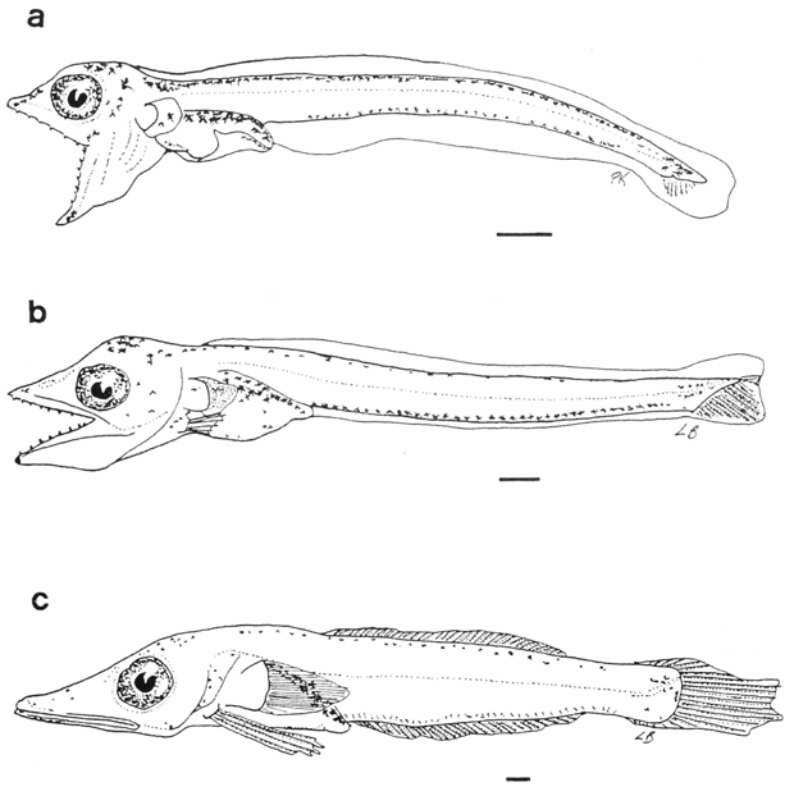

Fig. 10: Larvae of *Champsocephalus gunnari*. a) stage 2; c) stage 3; d) stage 4. Scale: 1 mm.

Channichthys rhinoceratus Richardson, 1844 (Fig. 11)

A juvenile from the Kerguelen shelf was described by Efremenko (1989). Hureau (1966) estimated that the spawning occurs during summer. More recent data provided by monthly shallow waters surveys showed that gravid females can be found throughout the year. Yolk-sac larvae were caught during spring and summer in the coastal zone.

Morphology and morphometrics: Table XXI. The larvae are long. The body is quite deep during the first two stages if compared to the larvae of

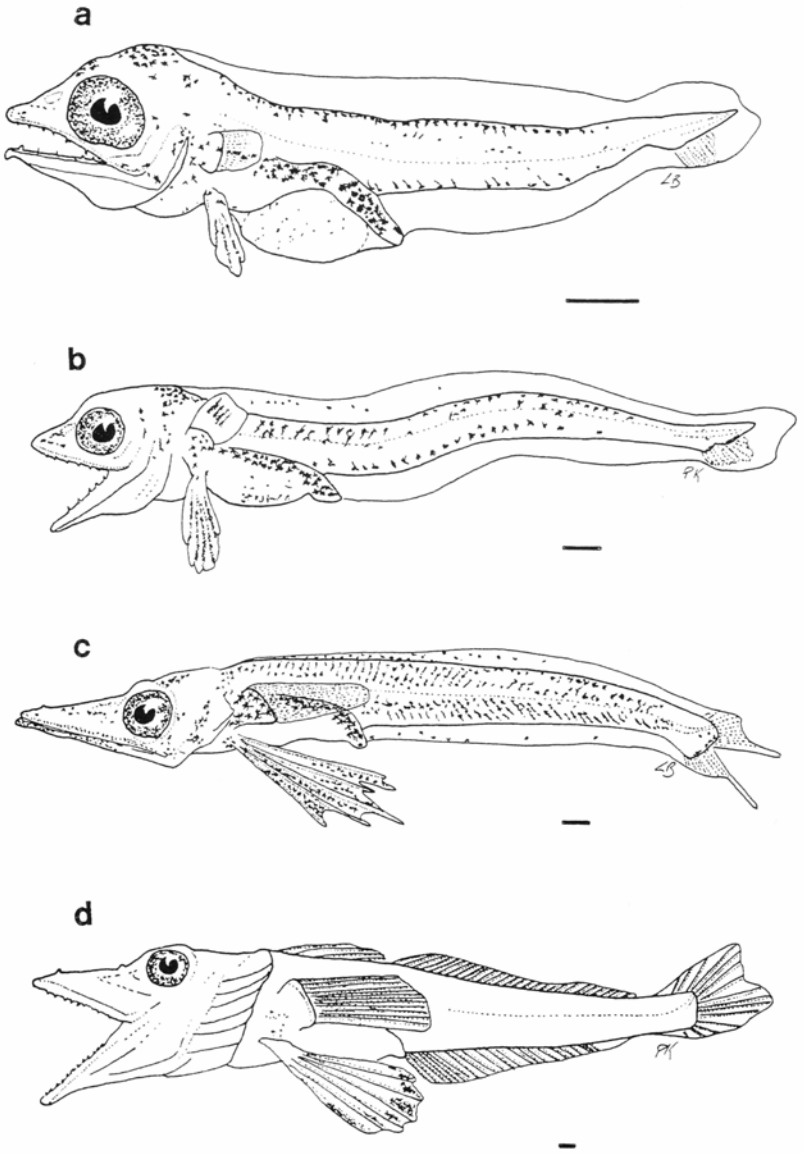

Fig. 11: Larvae of *Channichthys rhinoceratus*. a) stage 1; b) stage 2; c) stage 3; d) juvenile. Scale: 1 mm.

Table XIX: Morphological and meristic characters of larvae of *Champsocephalus gunnari*. For abbreviations, see Table III.

STAGE 1	n	avg	std	min	max
RL	4	15.51	1.27	13.8	16.7
BD (% RL)	4	9.91	0.86	8.6	10.9
HL (% RL)	4	20.03	1.69	17.4	22.2
ED (%HL)	4	36.45	2.47	32.7	39.5
PAL (% RL)	4	34.43	1.99	31.2	36.2
STAGE 2					
RL	10	16.24	0.92	14.3	18.1
BD (% RL)	10	9.41	0.76	8.2	10.6
HL (% RL)	10	17.99	1.07	16.2	19.5
ED (%HL)	10	40.52	5.10	35.0	49.0
PAL (% RL)	10	33.40	1.85	30.9	36.6
STAGE 3					
RL	8	18.99	1.95	15.9	22.4
BD (% RL)	7	12.56	1.23	10.4	14.1
HL (% RL)	7	24.48	3.29	19.1	27.7
ED (%HL)	7	31.54	4.16	27.4	39.4
PAL (% RL)	7	41.91	4.16	34.5	47.2
MYOMERES					
PRE-ANAL	19	12.74	1.12	11	15
POST-ANAL	19	43.74	1.58	41	47
TOTAL	19	56.47	1.63	54	59

Table XX: Melanophore pigmentation of *Champsocephalus gunnari*.

	EPIDERMAL		INTERNAL	
HEAD:	orbital	post-, few stellate	otolithic	> stage 3
	snout	few stellate	shoulder	some
	mandibular	some punctate		
	opercular	some stellate		
	occipital	lots of stellate		
	shoulder	no pigments		
BODY:	dorsal contour	double, continuous lines, 42 to 52	peritoneal	stellate, abundant
	ventral contour	single, stellate, 36 to 44	notochordal	no pigments
	medio-lateral	no pigments	haemal	no pigments
	abdominal	branched, anal; ventral, stellate		
	throat	some stellate		
FINS:	caudal	urostyle aggregation		
	pectoral	fin base		
	pelvic	no pigments		
	finfolds	no pigments		

Table XXI: Morphological and meristic characters of larvae of *Channichthys rhinoceratus*. For abbreviations, see Table III.

STAGE 1	n	avg	std	min	max
RL	5	15.78	4.26	11.5	22.3
BD (% RL)	4	11.65	1.49	9.8	13.7
HL (% RL)	4	20.68	1.85	18.8	23.1
ED (%HL)	4	33.20	3.98	30.0	39.8
PAL (% RL)	3	43.79	5.05	39.5	50.9
STAGE 2					
RL	1	18.12			
BD (% RL)	1	11.15			
HL (% RL)	1	19.37			
ED (%HL)	1	40.46			
PAL (% RL)	1	39.02			
STAGE 3					
RL	4	25.55	1.58	23.8	28.0
BD (% RL)	4	10.36	0.97	9.0	11.6
HL (% RL)	4	23.61	1.22	22.2	25.4
ED (%HL)	4	26.28	2.25	22.9	29.1
PAL (% RL)	4	41.34	3.69	39.0	47.7
STAGE 4					
RL	1	70.82			
BD (% RL)	1	15.35			
HL (% RL)	1	36.66			
ED (%HL)	1	16.45			
PAL (% RL)	1	54.74			
MYOMERES					
PRE-ANAL	5	13.80	0.40	13	14
POST-ANAL	5	38.80	0.40	38	39
TOTAL	5	52.60	0.49	52	53

Champsocephalus gunnari. The head is relatively large with a long flattened snout. Teeth are visible. The rostral spine on the anterior dorsal edge of the snout is apparent at stage 3. The eyes are round and large. Pelvic fins are also present as early as stage 1, their size is greater than that of *Champsocephalus gunnari*.

Pigmentation: Table XXII.

Table XXII: Melanophore pigmentation of *Channichthys rhinoceratus*.

	EPIDERMAL		INTERNAL	
HEAD:	**orbital**	post-, few stellate	**otolithic**	no pigments
	snout	few stellate	**shoulder**	some pigments
	mandibular	few stellate		
	opercular	no pigments		
	occipital	lots of stellate		
	shoulder	no pigments		
BODY:	**dorsal contour**	double, stellate, 42 to 50	**peritoneal**	branched, abundant
	ventral contour	double, stellate, 31 to 39	**notochordal**	no pigments
	medio-lateral line	stellate; stage 1 and 2, dorso-; stage 3, continuous myoseptal lines	**haemal**	no pigments
	abdominal	stellate on the ventral part, branched on anus		
	throat	some stellate		
FINS:	**caudal**	urostyle aggregation, on fin		
	pectoral	fin base and radial		
	pelvic	base and web		
	finfolds	few punctate on dorsal- and ventral-		

DISCUSSION

The early stages of ten species of Notothenioidei were described. Of all these species, complete descriptions (from the Atlantic sector) exist for *Notothenia squamifrons* and *Champsocephalus gunnari* (Efremenko, 1983, 1984). The larvae of *Notothenia acuta, Notothenia cyanobrancha* and *Nototheniops mizops* as well as *Harpagifer kerguelensis* and *Channichthys rhinoceratus* (all endemic species of the Kerguelen Islands) were described and identified from a complete series of early stages and by knowledge of the reproduction and ecology of these species.

Two species, *Notothenia rossii rossii* and *Dissostichus eleginoides* have not been completely described except for the early larvae. Their larvae were undersampled because no samples were taken off-shore in spring when these were likely to be found in zooplankton (they spawn at the beginning of winter).

One serie of larvae *(Nototheniidae sp.)* belonging to the Nototheniidae family could not be identified to species because of a lack of specimens and juveniles.

No larvae of *Paranotothenia magellanica* and *Notothenia coriiceps coriiceps* were caught. This was possibly because no sampling was undertaken in the nearshore intermediate zone where those two species live and probably spawn.

Our results on the study of Notothenioidei larvae from the Kerguelen Islands can help significantly in defining phylogenetic lineages between families, genera and sub-genera. The use of the embryonic, larval and juvenile stages to study the taxonomy of fish has become more common. Among the most complete works, are those of Moser and Ahlstrom (1970, 1972, 1974) on the Myctophidae; those of Bertelsen *et al.* (1976) on the Notosudidae and contributions published in the Ahlstrom Symposium on the ontogeny and systematics of fishes (Anonymous,

1984). On that occasion, Stevens *et al.* (1984) focused their attention on the Notothenioidei and summarized the larval characteristics of some of the families.

In terms of morphology, the larval Nototheniidae are characterized by elongate shaped larvae with a round medium sized head and a slightly pointed snout. Channichthyid larvae have well developed pelvic fins from the earliest stages, a long flattened-snout and developed teeth. The Harpagiferidae have a short broad deep body and from stage 3 the development of opercular and preopercular spines is apparent. Some characteristics are common to the three families, namely, the presence of large pectoral fins from the earliest larval stage, and the jugular position of the pelvic fins. Whatever the species (as for the meristic criteria) the total number of myomeres is inferior (from 2 to 4 elements) to the total number of vertebrae.

The sequence of fin formation is common to the Harpagiferidae and Nototheniidae. The pectoral and caudal fins form first (stage 2), followed by the pelvic fins, with dorsal and anal fins the last to form (stage 3). In larval Channichthyidae, the pelvic fins form early during development (Stevens *et al.*, 1984) and their size is more important than that of the two other families.

Since only a few species are represented by the Channichthyidae and Harpagiferidae, at the Kerguelen Islands, we have focused on the Nototheniidae. Larval pigmentation allows discrimination between both genera and sub-genera as defined in adults by Andersen (1984). The Kerguelen Islands species are divided into two sub-families, that of the Eleginopinae and that of the Nototheniinae.

As for the sub-family Eleginopinae, the only species in the area is *Dissostichus eleginoides*. The larvae from the Kerguelen Islands have an unpigmented ventral contour which fits the description made by Ciechomski and Weiss (1976) and Kellermann (1989) but is contrary to Efremenko's (1979b, 1983) juveniles description. The specific character is a vertical pigment band on the posterior part of the post anal section.

Among the sub-family Nototheniinae, the tribe Nototheniini is represented at the Kerguelen Islands by three genera: *Notothenia* (with 3 sub-genera), *Nototheniops* and *Paranotothenia*.

Notothenia: Two species of the *Notothenia* sub-genus are found in the Kerguelen Islands: *Notothenia rossii rossii* and *Notothenia coriiceps coriiceps*. The main characteristics concerning pigmentation of this sub-genus is that melanophores are scattered all over the body but are mainly concentrated on the dorsum.

The sub-genus *Lepidonotothen* is represented at the Kerguelen Islands by *Notothenia squamifrons*. The presence of a dorsal pigmented band (on the posterior part of the post-anal section) and the presence of a medio-lateral pigmentation row (3-7 stellate melanophores) above the pectoral fins, are the main distinctive characters for this species. The *N. squamifrons* larvae can be compared to those of *Notothenia kempi*, a closely related species. For the latter species, specimens from the Atlantic and Indian sector of the Southern ocean were described (Efremenko, 1979b, 1983; Duhamel, 1987; Kellermann, 1989). The pigmented band is also present but it extends further ventrally. Pigmentation above abdomen also exists. For both species, a slight occipital pigmentation appears later on.

In the sub-genus *Gobionotothen*, one can find two species endemic to the Kerguelen Islands: *Notothenia cyanobrancha* and *Notothenia acuta*. Larvae have a specific pigmentation pattern consisting of stellate melanophores spread on the occipital region, the ventral contour row, the peritoneum and the ventral part of the abdomen. The pigmentation on the dorsal contour row is double and is present at the yolk-sac stage in *N. cyanobrancha*, and from the postflexion in *N. acuta*. These two species quite similar as regards pigmentation can be also easily separated when taking morphology into account (Tables VII, IX). In this sub-

genus, larvae of *Notothenia angustifrons* and *N. gibberifrons* were described (Efremenko, 1979b, 1983; Kellermann, 1989). The pigment pattern of *Notothenia angustifrons* larvae is like that of *Notothenia acuta*. Gon and Klages (1988) considers that *N. angustifrons* and *N. marionensis* are synonymous and suppose that *N. acuta* may be so, too. Duhamel (1987a) considers that *Notothenia marionensis* is close or synonymous to *Notothenia acuta* when meristic characters are taken into account. If one considers larval pigmentation, these last hypothesis seem untrue, because in *N. angustifrons* the dorsal pigmentation is present from the first stages but this is not the case for *N. acuta*. Pigmentation of *N. gibberifrons* (Kellermann, 1989) is quite similar to that of *Notothenia cyanobrancha* but differs by the presence of a double medio-lateral line of stellate melanophores - observed by Efremenko (1979b) and Kellermann (1989).

Nototheniops: The larvae of *Nototheniops mizops* are characterized by their slight pigmentation. The pigment pattern consists of a ventral contour and of 1-3 melanophores on each side of the abdomen. Larvae of this genus were described for the Atlantic sector but the descriptions do not always match each other. For example, the *Nototheniops nudifrons* larvae described by Efremenko (1979 b) and Kellermann (1989) had a medio-lateral line of stellate melanophores and a heavily pigmented peritoneum. On the contrary, North and White (1982) indicated a lack of medio-lateral pigmentation for the same species. When focusing on *Nototheniops larseni,* the yolk-sac larvae described by Konecki and Targett (1989) are similar to *N. mizops* larvae. North and White's (1982) and Efremenko's (1983) descriptions of *N. larseni* larvae, underlined the presence of a medio-lateral line of stellate melanophores which does not match with the preceding description. Two different groups may exist in the *Nototheniops* genus, one with slightly pigmented larvae and the other one with larvae characterized by the presence of medio-lateral pigmentation. Further observations are necessary to permit a review of the phylogeny of this genus.

Paranotothenia: No descriptions of larvae of this genus exists. Only juveniles have been collected until now. Regan (1916) described two *Paranotothenia magellanica* specimens from the Kerguelen Islands caught with a tow-net by the H.M.S. "Challenger". Those were two juveniles 40 mm long. Their colouration does not match that of the adults. They are bright silvery, with the back bluish. Because of this, Regan concluded that these juveniles are pelagic. Recently, two other specimens were collected with the Bongo-net around the Kerguelen Islands. The first one is 44.9 mm long (SL) and was caught in February 1988 in the north- eastern part of the archipelago, the second one is 47.4 mm long (SL) from the Morbihan Bay (June 1989). These two juveniles correspond to the description given by Regan (1916). Because of their colouration and shape, they can be compared with the fingerlings of *Notothenia rossii rossii* called "blue phase" by Burchett (1983) and we speculate that *Paranotothenia* larvae may be as heavily pigmented as *Notothenia* sub-genus larvae.

The specimens named *Nototheniidae* sp. were not identified, even at the genus level. Larvae are characterized by the presence of a medio-lateral line of stellate melanophores. No certain identification can be made even when using meristic characters, geographical distribution and the period of their presence in plankton. Previous authors (North and White, 1982; Efremenko, 1983; Kellermann, 1989) gave descriptions of *Nototheniops* larvae - specially *Nototheniops larseni* - which were similar to those found around the Kerguelen Islands. One must add that a close related species of *Nototheniops larseni,* namely *Nototheniops tchizh* occurs at the Crozet Islands - also located in the Indian sector of the Southern ocean, in the west of the Kerguelen Islands. Thus, it is necessary to collect more larvae to identify this series.

As a conclusion, the study of the Notothenioidei phylogeny using the morphology and pigmentation of the larval stages can confirm the classification

given by Andersen (1984) for the Nototheniidae family. Morphology, as we already pointed out, allows the distinction between the three families. Sampling of fish larvae should be planned with regard to season and geographical location to enable us to correct the descriptions of Antarctic fish larvae. Species identification has to be the first study when ichthyoplankton is to be used for fisheries purposes (monitoring stocks and recruitment) (Moser and Ahlstrom, 1976). It may then be possible to estimate the success of each year class and to understand the factors regulating early survival.

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